

Discovery of Apraxia

Descoberta da apraxia

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ABSTRACT

Skilled movements certainly exist since the dawn of the humans, embedded in the actions of daily living, and also represented by tools and weapons making and use, as well as by artistic activities as drawing and engraving. A very long period of time elapsed until such actions were recognized as special, and the designation 'praxis' was attributed to such ability of produce refined movements. Another long time passed, and only recently disturbances of such actions caused by brain lesions were identified, leading to the concept of 'apraxia'. Studies on this subject progressed quickly, and in a few decades reached the state resembling to what is seen nowadays.

Keywords: praxis, apraxia, skilled movements, tools, weapons

RESUMO

Movimentos hábeis certamente existem desde a aurora dos humanos, incluídos nas ações da vida diária e também representados na feitura e uso de ferramentas e de armas, assim como por atividades artísticas como desenhar e gravar. Decorreu um longo período de tempo até que tais ações fossem reconhecidas como especiais e a designação de 'praxia' foi atribuída para tais habilidades para produzir movimentos refinados. Outro tempo prolongado passou, e apenas recentemente desordens de tais ações causadas por lesões cerebrais fossem identificadas, levando ao conceito de 'apraxia'. Estudos sobre esse assunto progrediram rapidamente e em poucas décadas alcançaram o estado que se assemelha ao que é visto atualmente.

Palavras-chave: praxia, apraxia, movimentos hábeis, ferramentas, armas

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INTRODUCTION

The varied kinds of movements include those that are complex, skilled or learned, comprising actions such as tool manufacture and use. Although present to some degree in many animal species, are uniquely developed in humans. According to archaeological records, tool use emerged about 2.5 Ma [stone age], starting with simple behaviors such as modifying rocks for pounding and then progressing towards the construction of more and more refined and complex compound tools through cumulative evolution^{1,2}. Speculations regarding evolutionary toolmaking have a very long history. Charles Darwin (1809-1882) himself observed: "... when primeval man first used flint-stones for any purpose, he would have accidentally splintered them, and would then have used the sharp fragments. From this step it would be a small one to intentionally break the flints, and not a very wide step to rudely fashion them...". And more: "To chip a flint into the rudest tool, or to form a barbed spear, or hook from a bone, demands the use of a perfect hand... the shaping fragments of stone into knives, lances, or arrow-heads, shews extraordinary ability and long practice"... And further: "...invented and is able to use various weapons, tools, traps, &c., with which he defends himself, kills or catches prey, and otherwise obtains food..."^{3,4}. Another evidence of skilled action can be seen in the representational abstract and realistic images, either painted or engraved, which began to appear in caves, rockshelters, and exposed rocky surfaces by 36 Ka (Figure 1)⁵.



Figure 1. Cave painting. Saharan rock art with prehistoric archers. Public domain. Creative commons. [https://commons.wikimedia.org/wiki/File:Algerien_Desert.jpg] This painting depicts the skilled representation of the figures, men and animals, in a hunting scene, as well as the use of arch-and-arrow weapon.

Thus, the development of skilled and learned movements [praxis] was already observed in the primitive man. Speculatively, it is possible that head injuries, which should

be frequent at the time ^{6,7,8} could produce several kinds of movement deficiencies in survivors. And why not loss of skilled movements?

Praxis - definitions

A very long time elapsed until a definition for skilled movements [praxis] appeared, as follows.

The process by which a theory, lesson, or skill is enacted, embodied, or realized described the concept and term 'praxis' [practice] (from Greek: praxis=action, doing). This has been a recurrent topic in the field of philosophy, since the classic antiquity. The philosopher Aristoteles (IV century BC) held that there were three fundamental modes of activities of the [human] logos [from Greek (Aristotelian): reasoned discourse] of the psyché: 'theoria' (thinking), 'poiesis' (making), and 'praxis' (doing). The concept of praxis is often taken to refer to the deliberate action of a rational being. Corresponding to these activities were three types of knowledge - theoretical, the end goal being truth; poietical, the end goal being production; and practical, the end goal being action^{9,10}.

The neurological translation of praxis means the ability to perform voluntary (purposeful) skilled movements. Several steps are required to perform such movements (e.g., of the upper limb): suitable posture the arm, forearm and hand; movement of the limb through space; adequate speed, force, and direction; independent coordinated and precise limb and finger movements. Additionally, a conceptual knowledge is needed - what action is associated with a tool or object, and how to perform a series of acts to achieve a goal¹¹.

A very long time later the clinical effects of loss of praxis was perceived.

ACTION DISORDERS - INITIAL DESCRIPTIONS

Many authors reported cases of action disorders before the advent of term and definition of apraxia, but the initial clear description of disordered movement, which would be classified as apraxia, apparently may be credited to John Hughlings Jackson (1835–1911), when studying voluntary and involuntary movements. The excerpts related to speech may serve as example: "...the patient seems to have lost much of his power to do anything he is told to do...he may be unable to put out his tongue when we ask him, although he will use it well in semi-involuntary actions, e.g., eating and swallowing..." (1866)^{12,13}.

Another important step for the clarification of the question was the advent of the concept of 'asymbolia'.

Carl Maria Finkelnburg (1832-1896), German psychiatrist, observed that gestures of communication in aphasics were clumsy and incomprehensible. He has observed that the problems were not limited to spoken language, but also concerned the gestural expressions. One of his cases is clear: "...a devout catholic ...when asked to make it [sign of the cross], she hesitantly reached sometimes behind the ear, sometimes to the neck, until it was demonstrated to her...then she imitated it correctly". He deduced that those aphasics suffered from a "disturbance of the symbolic brain function" (*Störung der symbolischen Gehirnfunktion*) or 'asymbolia' (*Asymbolie*), i.e., "a morbid disturbance of function where the ability to understand or express concepts by means of learned signs is partially or completely abolished" (1870)^{14,15}.

Carl Wernicke and Theodor Meynert further elaborated on the subject

Carl Wernicke (1848-1905), German psychiatrist, endorsed Finkelnburg's work, and regarded that the occurrence of "...a kind of loss of the meaning of an object...", related to the sense of vision, extensive to the senses of hearing and of touch, to be defined for an action, constituted what he designated as the 'Finkelnburg's asymbolia' (*Finkelnburg's Asymbolie*) (1874)^{16,17}.

Theodor Meynert (1833-1892), German psychiatrist and anatomist, reminded that Wernicke called 'asymbolia' the loss of memory images in the optical and acoustical senses, and in most cases also in the tactile sense¹⁷. Further, he elaborated the effects of selective asymbolia affecting memory images of motor actions: "...loss of the characteristics of an object is named 'asymbolia' (*Asymbolie*)...with respect to the motor modality - 'motor asymbolia' (*motorische Asymbolie*) - where the characteristics of the perception is also associated with the use of the object - asymbolia will be revealed by the patient's inability to make proper use of the object..." (1890)¹⁷.

The term 'motor asymbolia' found little recognition and soon vanished from the literature. However, limb-kinetic apraxia was the last descendant of Wernicke's and Meynert's 'motor asymbolia'¹⁵.

Finally, such disordered actions acquired a name: apraxia.

Apraxia – loss of skilled actions

Apraxia may be defined as an inability to correctly perform skilled or learned movements when asked (verbal commands), or to imitate gestures. Such inability cannot be caused by paralysis, sensory loss, incoordination, or superimposed involuntary movements. It is necessary that the request or command is understood (comprehension), and the individual is willing to perform the task (cooperation)¹¹.

The term apraxia (from the Greek: apraxia=in-action, or: a=without+praxis=action) was introduced by Chaim Heymann Steinthal (1823–1899), a German linguist, who described an aphasic and anarthric patient who maintained comprehension. While improving, when asked to write, he seized the pen in a wrong way (upside-down), and also took hold of spoon and fork as he had never used before; he asked for his violin, but gripped it so awkwardly that its use was impossible (1871, 1881). Steinthal explained: "...it was not the movement of the limbs that was inhibited, but the relationship between the movement and the object to be handled, the relationship between the mechanism and its purpose was disturbed". He concluded that: "Such 'apraxia' (*Apraxie*) was an obvious amplification of aphasia"¹⁸. This statement is generally recognized as being the first printed appearance of the term 'apraxia'¹⁵.

The true beginning of research on apraxia is usually identified with the writings of Hugo Karl Liepmann (1863-1925), German neurologist and psychiatrist, who can be considered as the central personage of such issue (Figure 2). Initially he described, in a seminal paper, a patient that suffered a left hemispheric stroke with aphasia (understanding maintained). He observed that the use of objects by the right hand was abnormal - when given a comb, he stuck it behind the ear like a pen, or he used a toothbrush like a pen, or put its handle into the mouth, or took the toothbrush like a spoon. There were no difficulties with his left hand. Thus, was identified a unilateral apraxia (1900)^{15,19,20}. Later, he published three consecutive papers (1905, 1905 and 1907) describing his new findings (1908). There he reported the examination of 42 patients with left-sided (right hemisphere lesions) and 41 with right-sided hemiparesis (left hemisphere lesions), as well as 5 aphasic patients without hemiparesis (left hemisphere lesions), which had the non-paretic hand assessed with varied tests. The analysis of his findings permitted to conclude that among the patients with right-sided hemiplegia 20 out of 41 committed clear errors with the left hand; on the other side, among the pa-

tients with left-sided paresis there were rare cases that failed in isolated tests with the right hand; some of the non-paretic aphasic patients displayed errors. He also proposed the anatomical underpinning with diagrams of the action disorders, centered in the left hemisphere^{15,21}. Additionally, he determined the role of [lesions] of the corpus callosum to explain bilateral apraxia from unilateral lesions of the left hemisphere (1907)²¹. There, he described the three types of apraxia he identified - limb-kinetic, ideo-kinetic, and ideational apraxia (Box)²¹.



Figure 2. Hugo Karl Liepmann (ca. 1915).
Public domain. Creative commons.
Source=<http://www.sammlungen.hu-berlin.de/dokumente/12540/>
[<https://commons.wikimedia.org/wiki/File:Liepmann.jpg>]

Box. Liepmann's classification of apraxia²¹. In square brackets a brief explanation of the deficiency¹⁵.

Liepmann identified three types of apraxia founded on the associationist theories of Wernicke and Meynert, defining them, as follows:

[1] **Limb-kinetic apraxia** (*Gliedkinetische Apraxie*): loss of purely kinetic (kinaesthetic or innervatory) inherent memories of an extremity

[subject lost hand and finger dexterity]

Other denominations: Wernicke='loss of movement concept' (*verlust der Bewegungsvorstellung*);

Meynert ='motor asymbolia' (*motorische Asymbolie*);

Kleist='innervatory apraxia' (*innervatorische Apraxie*)

[2] **Ideo-kinetic apraxia** (ideo-motor) (*Ideo-kinetische Apraxie*): the kinematic of the limbs is preserved but separated (dissociated) from the ideational general plan of the movement

[subject knows what to do but not how to do it]

[3] **Ideational apraxia** (*Ideatorische Apraxie*): the kinematic of the limbs is undamaged, in conformity with the ideational plan, but the latter itself is faulty

[subject does not know what to do]

Liepmann's work was well accepted, and further studies followed, his own and of other authors, as Arnold Pick (1902), Karl Heilbronner (1905), Kleist (1906), Samuel Alexander Kinnier Wilson (1908), and later by Derek Denny-Brown (1958), Norman Geshwind (1964), Henry Hécaen (1967), who published papers which acknowledged Liepmann's ideas, some offering further new explanations^{19,22}.

Parallel to Liepmann's and of his followers finding, appeared the construct of another type of apraxia.

CONSTRUCTIONAL APRAXIA

Walther Poppelreuter (1886-1939), German neuropsychiatrist, examined the action that resulted from the co-working of the optic system and goal-directed voluntary movements – the 'optic praxis' (*optische Praxie*), and observed the appearance of a clumsiness of the planned action, identifying impairments in activities requiring control of

vision on action, such as drawing, cutting a shape with scissors, building with blocks. Not entirely satisfied with Liepmann's classification for such disturbances, he proposed the term 'optic apraxia' (*optische Apraxie*) (1917)²³.

Poppelreuter may be regarded as a forerunner of Kleist's ideas that followed.

Karl Kleist (1879–1960), German psychiatrist, was influenced by Wernicke's ideas, and published his first article on apraxia (1906) where he analyzed Liepmann's work and other cases in the light of Wernicke's diagram interruption and of 'movement formula'²⁴. Kleist defined 'constructional (optical) apraxia' (*Konstruktive [optische] Apraxie*), based on 6 brain lesioned cases (1924, 1934), as: "...disturbances of action...that arise in formative actions (assembling, building [constructing], drawing, and other similar), and where the spatial form of the composition is failed, although there is no apraxia of the single movements", He acknowledged that other authors had already detected spatial disturbances, as Conrad Rieger (1909), Liepmann (1912), and Poppelreuter (1917), as already seen^{25,26}.

His disciple and collaborator Hans Strauss (1898-1977) followed his steps, and adopted the term 'constructional apraxia' for the distinct variant of apraxia depending upon the need for visual control of actions (1924)^{15,26}. He credited Kleist for having first described constructional apraxia, and also quoted several sentences of his book (in press at that time) [published in 1934], literally, as he had read the original manuscript²⁷. Thus, they distinguished a new form of apraxia from those described by Liepmann, a legacy of both²⁷.

The definition of constructional apraxia diverged in the years that followed – some authors endorsed Kleist's concept, others classified it as 'visuo-constructional' disability, to refer to whatever disorder observed in assembling and drawing tasks²⁷.

OTHER TYPES OF APRAXIA

The term apraxia is sometimes extended to embrace a wide range of motor impairments, including 'speech apraxia' (difficulty coordinating mouth and speech movements), 'gait apraxia' (disturbance of ambulating), 'dressing apraxia' (inability to coordinate activities with multiple, sequential movements for dressing), and others (orofacial, oculomotor)²⁸, which will be seen in another opportunity.

CONCLUSION

Skilled goal-directed movements certainly exist since the dawn of the humans, embedded in the actions of daily living, and also represented by tool and weapon making and use, as well as what can be regarded as artistic production, drawing and engraving. A very long time elapsed until such actions were recognized as special, and the designation 'praxis' was attributed to such ability of produce refined movements. Another long period passed until disturbances of such actions caused by brain lesions were identified, leading to the knowledge of 'apraxia', a concept that emerged in the early XX century and quickly consolidated in its main features a few decades later, when it reached to what is seen nowadays.

CONFLICT OF INTEREST

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